2015
NOAA/ESRL
Basic Radiation Safety Training

Chemical Sciences Division (CSD)
Global Monitoring Division (GMD)

Additional resources at:
www.esrl.noaa.gov/csd/safety/
www.esrl.noaa.gov/gmd/safety/

Rev. 01-Dec-14

Agenda - Radiation Safety Training:

- Duties/Users
- What is radiation?
- ALARA
- Regulations
- License Requirements
- What we have
- Biological Effects/Exposure/Dose Limits
- Labeling
- Security
- Shipping/Receiving
- Summary

ESRL Radiation Safety Officers:

RSO:

John Schneider, GSD x4646

Assistant-RSO(s):

Ann Middlebrook, CSD x7324

Brian Vasel, GMD x6655

Radiation Safety Advisor:

Rhonda Carpenter, SECO x3912

3 Different Types of Users:

- ***Radiation Safety Officer (RSO) and Assistant-RSO(s)***
  - Radiation safety program oversight (ESRL and Divisions)
  - Training: 40-hrs of radiation safety training
  - Named on the NRC license

- ***Authorized User***
  - Research program and instrument oversight
  - Training: yearly refresher (these slides)
  - Named on the NRC license

- ***Radiation User***
  - Work with instruments
  - Training: yearly refresher (these slides)
  - NOT named on the NRC license

RSO & Assistant-RSO Responsibilities:

- Support safe activities
- Train personnel
- Control inventory and disposal
- Maintain records
- Audit program annually
- Perform surveys
- Ensure security
- Interact with NRC, other authorities
- Investigate abnormal events
- Supervise decontamination
- Identify and correct unsafe practices

Authorized Users:

- Rhonda Carpenter, SECO
- Brian Vasel, GMD
- Geoffrey Dutton, GMD
- James Elkins, GMD
- Brad Hall, GMD
- Fred Moore, GMD
- Eric Hintsa, GMD
- Ann Middlebrook, CSD
- Ru-Shan Gao, CSD
- James Roberts, CSD
- Troy Thornberry, CSD

As listed on the NRC license

Authorized User – Responsibilities:

- Supervise the use of licensed material
- Ensures that materials are used safely
- Materials used in compliance with regulatory requirements
- Ensure procedures and engineering controls keep occupational and public doses ALARA (as low as reasonably achievable)
- Security
- Respond to events to reduce spread of contamination
- Report all material movements to RSO

Radiation User Responsibilities:

- Notify RSO when purchasing or leasing new material
- Responsible for material from cradle to grave
- Keep track of material
- Keep licensed materials secure (locked or under surveillance) at all times
- Keep materials sealed. DO NOT TAKE THEM APART
- Dispose of properly. DO NOT THROW THEM AWAY

Definition of Radiation:

- Ionizing Radiation – consist of highly energetic particles or waves that can detach (ionize) at least one electron from an atom or molecule. Ionizing ability depends on the energy of the particles or waves, not their number.

- Examples: beta, neutrons, alpha, gamma, x-ray

Ionizing Radiation Characteristics:

- alpha
  - slow moving
  - only move a few cm in air
- beta
  - same mass as electron
  - + or – charged
  - highly variable
  - can move 20 feet

Ionizing Radiation Characteristics:

- gamma
  - can travel thousands of feet in the air
  - no mass no charge
  - can ionize matter
  - originate from nucleus
- x-ray
  - originates from electron

Ionizing Radiation Uses:

- Medical and dental x-rays
- Construction
- Research
- Atmospheric testing
- Static elimination

“ALARA”…

- As Low As Reasonably Achievable

- Achieved by:

  Time

  Distance

  Shielding

  Containment

Ionizing Radiation Regulations:

- OSHA:
  - 29 CFR 1910.1096

- Nuclear Regulatory Commission:
  - License
  - Federal facilities
  - 10 CFR 19, 20, NUREG 1556, vol 7

NRC License Requirements:

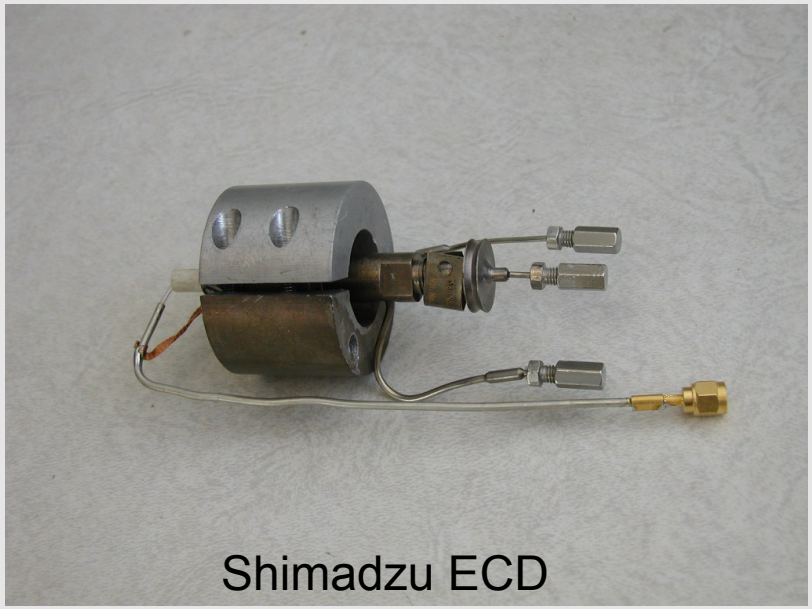
- Wipe test every 6 months <.005 uci
- Training (yearly)
- Inventory
- Moving/transporting procedures
- Security
- Purchasing
- Material control and accountability
- Annual audits
- Disposal

What we have at ESRL:

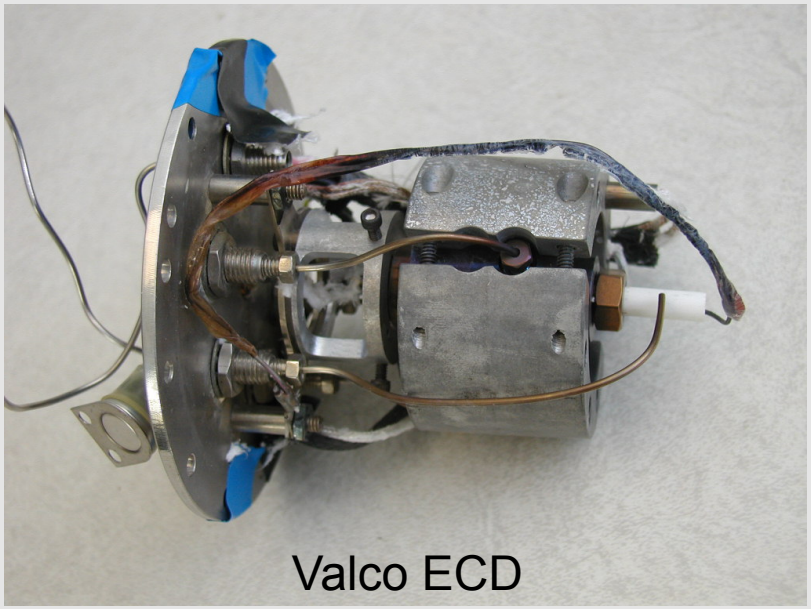
- ***Nickel 63 – beta emitter***
  - Gas chromatographs
  - Sealed Source
  - Very low risk
- ***Americium 241 - alpha emitter***
  - Chemical ionization mass spectrometers
  - Sealed source
  - Very low risk
- ***Polonium 210 – alpha emitter***
  - Generally-licensed unless in custom source holders
  - Static eliminators
  - Chemical ionization mass spectrometers
  - Sealed source
  - Very low risk

Typical ECD cells: (~1” dia, 1” long)

Used in GMD GC instruments.



Shimadzu ECD



Valco ECD

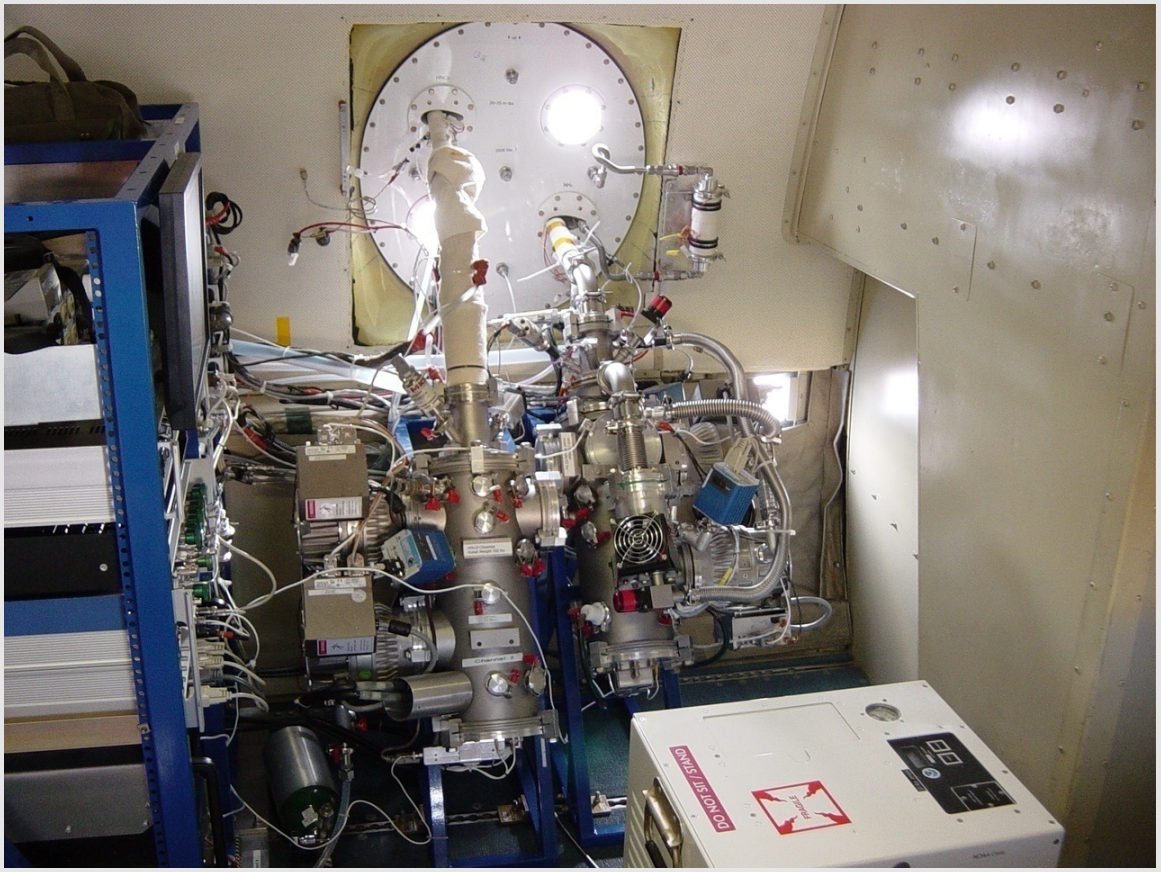
Wipe tests must be done every 6 months on working ECDs. Additional wipe tests may be required for field missions (contact assistant-RSO). The test sheets should be wiped on the exhaust port on the outside of the can or ECD. Unused ECDs are stored in locked cabinets or drawers at the DSRC in Boulder, CO.

NRD Po-210 Sources: (~1”dia, 5” long)

Used in CSD DMAs and CIMS instruments.

Po-210 in CIMS Instruments:

Example CSD HNO3 and NH3 Instruments: Andy Neuman



* Not shown PANs CIMS, Jim Roberts, CSD and other CIMS instruments in use or development

Po-210 in DMA Instrument:

Used by CSD for particle studies

Biological Effects of Radiation:

- Depends on level of exposure
- Affects the person exposed
- Can affect future generations
- Massive tissue damage and death

Results of Exposure:

- Cell damage or cell death
- Abnormal cells – cancer
- Damage depends on time, dose, and organ exposed
- Evidence of exposure may not be noticed for years
- Long-term vs. short-term exposure
- Causes other than radiation

Chronic Exposure:

- Low levels of radiation over a long time period
- Effects observed some time after initial exposure
- Genetic effects, cancer, lesions, tumors, cataracts, congenital defects

Acute Exposure:

- Large single dose of radiation
- Accidents or special medical procedures
- Immediate effects – radiation sickness
- Delayed effects – cataracts, sterility, cancer
- Death within a few hours or days

Emergency Procedures:

- ***If there is an injury, treat the injury first.**

- Damage to sealed source holder:
  1 - Evacuate immediate vicinity
  2 - Place a barrier safe distance (min. 5 meters)
  3 - Put up radiation hazard sign
  4 - Contact RSOs

Emergency Procedures: (continued)

- Personal Decontamination:
  - soap and water in a bucket
  - do not abrade skin; blot dry
- Spill and Leak Control:
  - notify everyone in area
  - confine the problem
  - clear area
  - summon aid
- Emergency Protective Equipment:
  - gloves, footwear covers, safety glasses, outer layer protective clothing

Annual Dose Limits for Occupational Exposed Person:

- 10 CFR 20.1201
- Skin 50 rems
- Elbows to hands 50 rems & knees to feet 50 rems
- Eyes 15 rems
- Internal Organs 50 rems
- or Total effective dose equivalent 5 rem

- **For Polonium 210 estimated exposure is less than 2 mrem/yr if person is within 2 ft of the source for 8 hrs/day

Dose Limits for Embryo/Fetus:

- 10 CFR 20.1208

- "The licensee shall ensure that the dose equivalent to the embryo/fetus during the entire pregnancy, due to the occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv)."

Ni 63 exposure – from sealed source:

- If the ECD source is EXPOSED (i.e. opened or melted):
  - 6 inches of air (at STP) – would block majority of beta
  - Skin dose – skin would block all beta
  - Eye dose – eye membrane will block all beta
  - Ingestion dose – source eaten, 8.3 rem
  - Inhalation dose – if vaporized and all vapors were inhaled, dose 93.75 rem

- Example: Unshielded source at 16 cm (6.375 inches); requires continuous exposure of 1,471 hours (61.3 days) = annual public acceptable dose limit 100 mrem.

Common “Other” Exposures:

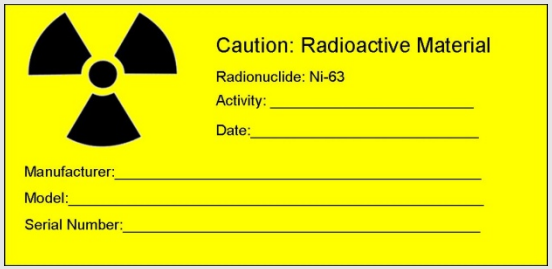
• Chest X-ray	20 mrem
• Dental X-ray	200-700 mrem
• Jet flight (cx country)	5-10 mrem
• Smoking cigarettes (@ 1.5 packs/day)	22 mrem/day
• Pacemaker	2 mrem/day

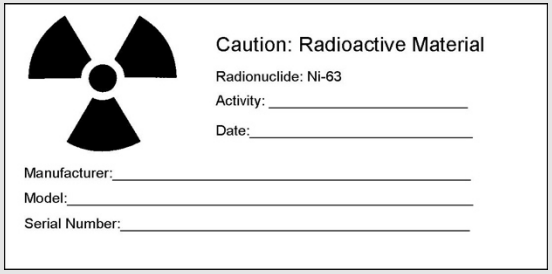
ECD Labeling:

NOAA has labeled all ECD sources with appropriate labels attached to the source. In situations where a label constitutes a fire hazard (sources that are installed in heated zones or cans), external labels will consist of metal tags that are thin wired to the can or enclosure. Both the source and cans will be labeled.

Each label includes:

A. Caution, Radioactive Material;
B. Shall contain the radiation symbol in black
C. Radionuclide; Manufacturer's estimated activity;
D. Date of purchase;
E. ECD serial number;
E. ECD manufacturer's name and model number.





ECD Security:

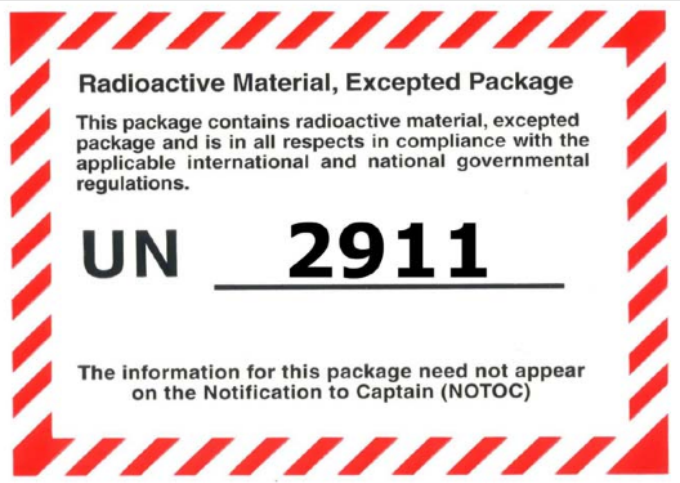
NOAA/ESRL has secured <u>every</u> licensed radioactive source in one of the 3 following manners:

- All sources "in use" are secured:
  1. Within a locked room (24hrs/day, 7days/week)

     -or-
  2. In an unlocked room with the ECD locked into the instrument <u>and</u> the instrument locked to the table in the lab. *Doors unlocked during business hours and locked outside of business hours.* (This bullet only applies to the DSRC.)

- All sources "in storage" are secured:
  3. Stored in a designated locked location in the DSRC with limited access. (24hrs/day, 7days/week)
     - *Room GD424 for GMD*
     - *In a locked drawer/cabinet for CSD*

NOAA DSRC Procedures for Shipping & Receiving Radioactive Materials:



*** No radioactive shipments will be picked up or delivered to the DSRC by Bldg 22 staff.* ***All transport*** *between DSRC and Bldg 22 must be done by an authorized user.*

Shipping Radioactive Materials:

When a package containing radioactive materials needs to be shipped (from field site → Boulder or Boulder → field site):

- The package/box MUST be closed and labeled by a HAZMAT certified shipper (DOT-49CFR and IATA).
- The box/labeling must meet DOT and IATA compliance.
- The Assistant-RSO must be notified of the shipment.
- The project PI/contact must be notified of the shipment.
- The recipient HAZMAT certified shipper must be notified of the shipment.

*ESRL has a written SOP for shipping an ECD and this protocol **must** be followed for all shipments.*

Shipping Notifications:

Anytime a package is being shipped the following 4 people should be in contact about the shipment IN ADVANCE:

- The project PI/contact.
- The Assistant-RSO.
- The origin HAZMAT certified shipper.
- The recipient/destination HAZMAT certified shipper.

Receiving Department (Boulder):

- When packages bearing radiation labels arrive, they are to be inspected for visible damage, moisture and stains.
  - If there is evidence of damage:
  1. Receiving will request the deliverer (vendor) to remain until the RSO has inspected and monitored the package.
  2. The RSO may approve or reject the package for delivery.
  3. The RSO must inspect and possibly wipe test the package within 3 hours of receipt at Bldg 22.
  - If there is NO evidence of damage: receiving will call the person the package is addressed to (only authorized users) for pickup at Bldg 22.

No radioactive shipments will be delivered to DSRC.

Pickup at Bldg 22 by Trained Personnel Only (authorized users):

- Verify from the shipping documents that the radioactive material in the package is what was ordered.
- The package must be opened by a trained person - who took this training.
- Move the package to a designated radioactive work area.
- Put on protective gloves before proceeding with opening the package.
- Open the package, remove the radionuclide holder, and examine for damage.
- *If damaged, contact the RSO immediately to wipe test the external surface of the radionuclide holder and all packaging.*

If Nothing Is Damaged:

- Notify the RSO of what was received and when.
- If the material will not be immediately used, secure it from unauthorized removal or access by locking either the room or the container.
- Deface ALL radioactive material symbols and labels on the packaging.

Training Summary:

- NRC License – what we have committed to:
  - Wipe testing every 6 months for active ECDs
  - Record keeping
  - Deployment Records
  - Transfer Records
  - Inventory
    - Physical location at any time

Training Summary: (continued)

- Security – locked & authorized individuals only
- Proper disposal
- Annual Audits
- Training
- RSOs have stop work authority and delegated authority from management
- Following written procedures for assembly/ disassembly

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After reading this presentation, you must print out the "Read and Sign" document (link below) and give it to either Brian Vasel (GMD) or Ann Middlebrook (CSD).

Link: http://esrl.noaa.gov/gmd/safety/radioactivematerialtrainingrecord.pdf

THANK YOU for your time!

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